

New catalog of neutron capture gamma rays for prompt gamma activation analysis*

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Neutron capture gamma-ray spectroscopy has been one of the most important tools when determining level schemes of nuclei along the stability valley. Nevertheless, the evaluated (ENSDF) data sets for many nuclides are incomplete and/or inconsistent, and most of the gamma-ray intensities are of poor quality due to calibration and normalization problems. For that reason, the capture gamma rays of all stable elements, except He, were remeasured at the guided thermal neutron beam facility of Budapest Research Reactor. Energies, relative intensities and partial production cross-sections were determined with high precision for nearly 7000 gamma rays of about 140 isotopes of the 82 stable elements considered.

The new data library¹ is quite complete for light nuclei, hence capture cross-sections can be inferred from the measured partial gamma-ray production cross-sections. Alternatively, for heavy nuclei the completeness of decay schemes can be assessed from a comparison with integral cross-section data. From a simultaneous observation of short-lived decay, several isomer production cross-sections can be determined as well. The new data will be used to update the ENSDF sets, in the framework of an IAEA coordinated research project. Besides, they will serve as a primary database for prompt gamma activation analysis, a chemical method of elemental analysis utilizing neutron-capture gamma rays.

The high flux, negligible divergence and low background, provided by a new guided cold neutron beam, open new vistas for the study of neutron capture and neutron-induced fission on the minor actinides. The observation of prompt gamma radiation from fission fragments completes the knowledge of level schemes, which has been limited by the selective nature of beta decay, and the spin of the fragments. The prompt radiations can also be used for determining the individual fission yields of the shortest-lived fission products. The new data on capture gamma rays and fission products may also be useful for neutron interrogation of fissile materials in nuclear waste.

1 G. L. Molnar, Zs. Revay, T. Belgya, R. B. Firestone, Appl. Radiat. Isot. 53 (2000) 527

* Supported in part by the US-Hungarian Joint Fund and the IAEA.